XI International Conference on Computational Methods in Marine Engineering

Numerical study of the fluid-structure interaction in submerged aquatic canopy using immersed boundary-lattice Boltzmann method

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ABSTRACT

Coastal canopies, such as seagrass meadows and kelp forests, provide food, habitat and shelter for many marine organisms. These submerged canopies positively influence water quality by recycling nutrients, producing oxygen and stabilizing sediment, Denny and Cowen (1997). The dominant characteristic of the flow is a shear layer generated at the top of the canopy, and the shear layer generates coherent vortices because of the Kelvin-Helmholtz (KH) instability. Consequently, these vortices control the vertical exchange of mass and momentum, and flush the canopy to complete the nutrient and sediment transport, Zhu et al. (2020). In this study, we numerically examine the flow over submerged aquatic canopies based on the immersed boundary-lattice Boltzmann method. Within this framework, the reconfiguration, the subsequent fluid and structure dynamics and the Kelvin-Helmholtz (KH) instability are analysed in detail. The results show that the coherent vortices could induce the secondary flow circulations, resulting in the mass and momentum exchange in the canopy flow.

References

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